

Amendments to the Specification

Please amend the paragraph starting on page 13, line 13 as follows:

FIG. 1 exhibits another embodiment of the invention, which employs a laser and a lens 44 13 to direct optical energy into a cloud of discrete particles produced by the atomizer 42 12. This optical energy propels the particles in a desired direction of flight.

Please amend the paragraph starting on page 17, line 6 as follows:

FIG. 2 is a schematic illustration of an alternative embodiment of the invention, which includes a hollow core optical fiber 19. The invention has the following features:

Small droplets (~1 μm):

Dense aerosols (~ 10^{16} m^3):

Accuracy to 3 μm :

Single particle to 10^9 particles/s:

Throughput to 0.25 mm^3/s :

Low power (~ 50 mW):

High scan rate (~1 m/s):

Dense, conductive materials ($\rho \sim 2\text{x}$ bulk).

Please amend the paragraph starting on page 17, line 8 as follows:

FIG. 3 reveals some details of an aerosol chamber 20, which is used to create discrete particles of a source material. Ultrasonic transducer 22 atomizes material 10 in aerosol chamber 20. Aerosolized particles of material 10 are then entrained in gas flow 24 and forced out of aerosol chamber 20 by gas flow 24, preferably to the delivery system. Gas flow 24 optionally comprises air. Some features of the aerosol chamber of the present invention include:

Small droplets (~1 μm , 1 fL);

Dense aerosols (~ 10^{16} m³);

100 μL minimum sample;

All solids, all precursors, or solid/precursor mixtures;

Precursor based alloys with atomic scale mixing;

Organic and biological entities in droplets (enzymes, proteins, virus, etc.).

Please amend the paragraph starting on page 17, line 10 as follows:

FIG. 4 portrays a compressed air jet- jet 26 having the following features:

Particulate in Suspension;

Large Particles (1-30 μm);

High Viscosity Fluids;

Particles + Precursor binder;

Animal Cells + Media;

Bacteria;

Virus.

Please amend the paragraph starting on page 17, line 11 as follows:

~~FIG. 5 offers another view of~~ 5(a) depicts a schematic for one of the preferred embodiments of
the invention. In this embodiment, particle laden air 50 enters deposition head 55 through ports 56, 58.
Sheath air 60 enters through ports 62, 64 to surround particle laden air 50. The air/particle stream then is
narrowed as it passes through nozzle 66. Coflowing air 70 then surrounds the stream, forming jet 72
which impinges on substrate 80. Laser beam 85 passes through lens 90 and glass window 92 for
processing the particles in jet 72 or on substrate 80. FIG. 5(b) depicts a computer simulation of particle
flow for an alternative embodiment in which the particle laden air enters the deposition head through ports
in the side of the deposition head.

Please amend the paragraph starting on page 18, line 7 as follows:

Cascade Impaction

Cascade impaction is a method which may be used to sort larger particles from smaller ones. FIG. 6 presents a pictorial description of the cascade impaction method. A gas stream 100 is produced to carry particles of material of varying size and mass. This gas stream is projected through a nozzle 110 towards an impaction plate 120. In a steady state condition, the gas produces streamlines above the impaction plate. Particles with larger mass and greater momentum are projected through these streamlines, and strike the impaction plate directly at impaction point 130. These particles accumulate on the surface of the impaction plate. Particles with smaller mass and less momentum are carried in the streamlines, and generally do not strike the impactor plate. These smaller particles continue to travel in the gas stream 132, 134, commonly know as the "major flow."

Please amend the two paragraphs starting on page 19, line 3 as follows:

Virtual Impaction

~~The larger particles may be utilized by employing virtual impaction. Virtual impaction uses the same principles as cascade impaction, except that an orifice allows the larger particles to continue down stream.~~

FIG. 7 supplies a schematic view of a virtual impactor. Virtual impaction uses the same principles as cascade impaction, except that an orifice 140 allows the larger particles to continue down stream in a "minor flow" 150. The fundamental difference between a cascade and virtual impactor is that the larger particles are preserved in the gas stream using the virtual impactor. Thus the larger particles may be utilized by employing virtual impaction.

Please amend the paragraph starting on page 21, line 1 as follows:

Method 1 – A Series of Virtual Impactors

FIG. 8 shows one method of densifying the gas stream. The first method involves placing a number of virtual impactors in series to strip off the excess gas. The first impactor strips off both carrier gas and the smaller particles. After minor flow 150 is passed through second nozzle 160, the ~~The second~~ virtual impactor (and any number after) strips off only carrier gas in second major flow 170, 172 while the larger particles flow through second orifice 180. In this method, a series of virtual impactors can be used to densify the gas stream by stripping off more and more of the carrier gas.

Please amend the paragraph starting on page 21, line 8 as follows:

Method Two – Particle Sorting at the Atomizing Unit

FIG. 9 shows a second method to ~~density~~ densify the gas stream. This method employs a virtual impactor (not shown) at the exit of the atomizing unit. This impactor would be used to sort the particle stream prior to introduction into the gas stripping virtual impactors~~[[.]]~~ so that only large particles remain entrained in entering particle/gas stream 182. FIG. 9 depicts two air-stripping virtual impaction stages. The first stage comprises nozzle 184; only carrier gas is removed in first major flow 186. Initially densified particle/gas stream 187 then passes through first orifice 188 and second nozzle 190, after which more carrier gas is stripped off in second major flow 192. Further densified particle/gas stream 194 then passes through second orifice 196. Both major flows strip off carrier gas only; no particles are removed from the particle/gas streams. Essentially, all of the particles in the gas stream would be sized to permit a direct pass through each gas stripping virtual impaction stage.

Please amend the paragraph starting on page 23, line 22 as follows:

This embodiment starts with the circuit designers CAD file. Proprietary software algorithms are used to translate the *.dxf CAD directly to a machine tool path. The next step is the deposition process where metal or ceramic inks, particulate suspensions, or commercial pastes are aerosolized and then focused into a deposition flow stream and onto a substrate as shown in FIG. 10. FIG. 10 reveals one embodiment of a Flow Guided Deposition System, in which liquid inks and pastes are atomized to form a dense aerosol of droplets and particulates. The aerosols are entrained in a gas flow and fed into a proprietary deposition head 200. The co-flowing sheath gas creates the aerodynamic forces to focus the aerosol stream. Finally, the streams are directed through nozzle 210 onto a substrate and mesoscale devices directly written. The current line width capability is down to about 25 microns, and the thickness capability is up to 100's of microns.

Please amend the paragraph starting on page 25, line 16 as follows:

Flow-Guided Deposition

The output mist is entrained in a gas flow (aerosol stream), and is fed into the flow-guided deposition head. The mass throughput is controlled by the aerosol carrier gas flow rate. Inside the head, the mist is initially collimated by passing through a millimeter-sized orifice as shown in FIG. 11. FIG. 11 reveals a flow guide head, showing the particle stream, focusing orifice, and the sheath gas flow. The aerosol stream 300 passes through an initial orifice 310 serving as the primary focusing point. Then the sheath gas 320 is annularly fed around the aerosol stream and fed through a second orifice 330, preferably sub-millimeter sized, thus focusing the stream further. ~~The emergent particle stream is then mixed with an annular sheath gas, and the combined streams are focused through a second, sub-millimeter sized orifice.~~